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United States
Department of
Agriculture

**Soil
Conservation
Service**

**Bozeman,
Montana**

Montana
Water Supply Outlook

October 1, 1989

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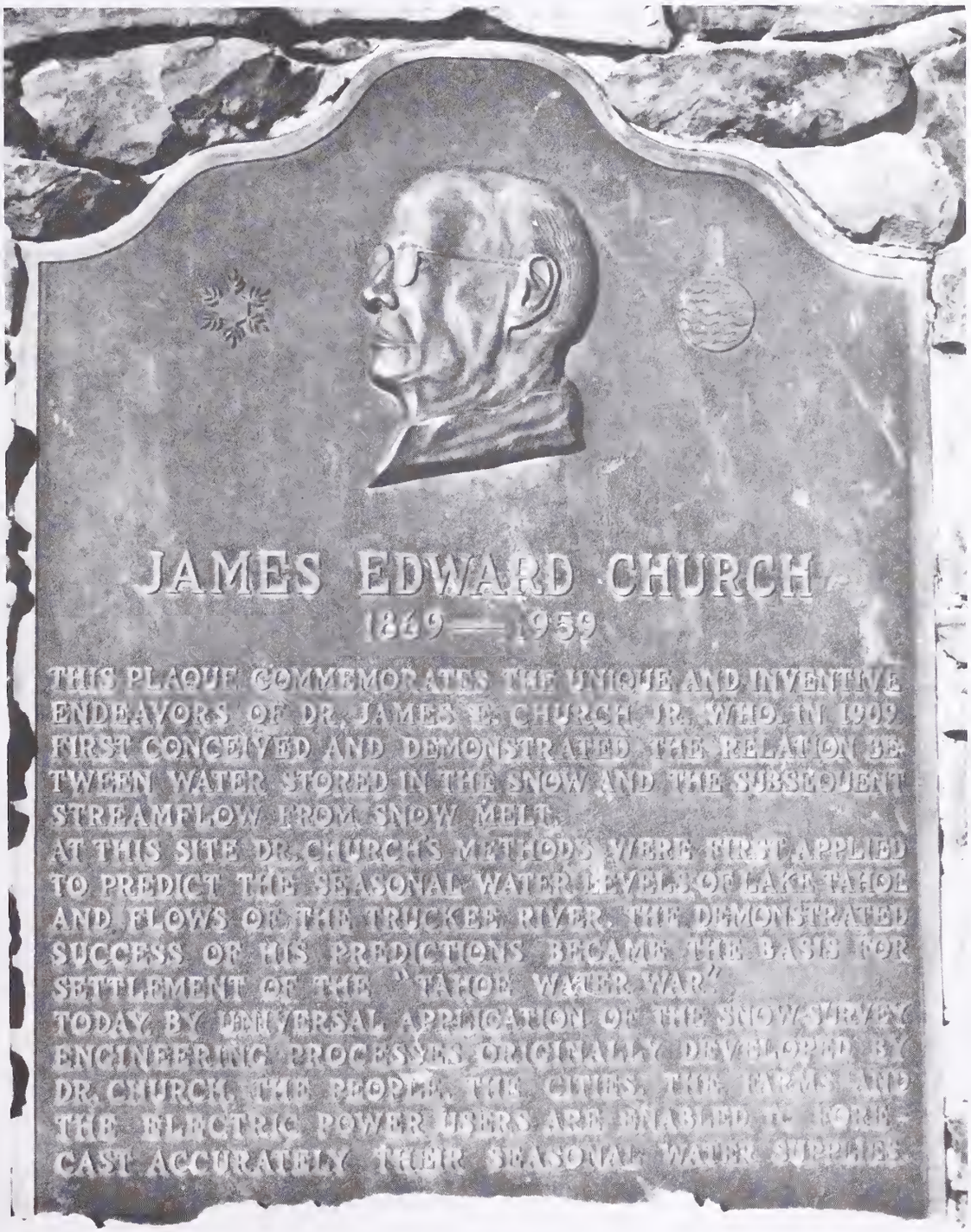
JAMES EDWARD CHURCH
1869 — 1959
THIS PLAQUE COMMEMORATES THE UNIQUE AND INVENTIVE
ENDEAVORS OF DR. JAMES E. CHURCH JR. WHO IN 1909
FIRST CONCEIVED AND DEMONSTRATED THE RELATION BE-
TWEEN WATER STORED IN THE SNOW AND THE SUBSEQUENT
STREAMFLOW FROM SNOW MELT.
AT THIS SITE DR. CHURCH'S METHODS WERE FIRST APPLIED
TO PREDICT THE SEASONAL WATER LEVELS OF LAKE TAHOE
AND FLOWS OF THE TRUCKEE RIVER. THE DEMONSTRATED
SUCCESS OF HIS PREDICTIONS BECAME THE BASIS FOR
SETTLEMENT OF THE "TAHOE WATER WAR."
TODAY, BY UNIVERSAL APPLICATION OF THE SNOW SURVEY
ENGINEERING PROCESSES ORIGINALLY DEVELOPED BY
DR. CHURCH, THE PEOPLE, THE CITIES, THE FARMS AND
THE ELECTRIC POWER USERS ARE ENABLED TO FORE-
CAST ACCURATELY THEIR SEASONAL WATER SUPPLIES

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Foreword

How Forecasts Are Made

Most of the annual streamflow in the Western United States originates as snowfall that has accumulated high in the mountains during winter and early spring. As the snowpack accumulates, hydrologists estimate the runoff that will occur when it melts. Predictions are based on careful measurements of snow water equivalent at selected index points. Precipitation, temperature, soil moisture and antecedent streamflow data are combined with snowpack data to prepare runoff forecasts. Streamflow forecasts are coordinated by Soil Conservation Service and National Weather Service hydrologists. This report presents a comprehensive picture of water supply outlook conditions for areas dependent upon surface runoff. It includes selected streamflow forecasts, summarized snowpack and precipitation data, reservoir storage data, and narratives describing current conditions.

Snowpack data are obtained by using a combination of manual and automated measurement methods. Manual readings of snow depth and water equivalent are taken at locations called snow courses on a monthly or semi-monthly schedule during the winter. In addition, snow water equivalent, precipitation and temperature are monitored on a daily basis and transmitted via radio telemetry to central data collection facilities. Both monthly and daily data are used to project snowmelt runoff.

An error is associated with each forecast, and this error decreases as the season progresses and more data becomes available. To express the range of error that can be expected, "most probable" forecasts are issued along with a range representing a "reasonable minimum" and a "reasonable maximum". Actual streamflow can be expected to fall within this range in eight out of ten years. Additionally two specific scenarios are provided based on the assumption that subsequent precipitation will be "wet", above average, or "dry", below average.

For More Information

Copies of Monthly Water Supply Outlook Reports and other reports may be obtained from the states listed below. An annual snow survey data summary is published by the Soil Conservation Service for each of the western states. Historical snow survey data may be obtained at those same offices.

STATE	ADDRESS
Alaska	201 East 9th Ave., Suite 300. Anchorage, AK 99501-3687
Arizona	201 East Indianola Ave., Suite 200, Phoenix, AZ 85012
Colorado	2490 West 26th Ave., Building A, 3rd floor, Denver, CO 80211
Idaho	3244 Elder Street, Room 124, Boise, ID 83705
Montana	10 East Babcock, Room 443, Federal Building, Bozeman, MT 59715
Nevada	1201 Terminal Way, Room 219, Reno, NV 89502
New Mexico	517 Gold Ave. S.W., Room 3301, Albuquerque, NM 87102-3157
Oregon	1220 Southwest 3rd Ave., Room 1640, Portland, OR 97204
Utah	4402 Federal Building, 125 South State Street, Salt Lake City, UT 84147
Washington	W. 920 Riverside, Room 360, Spokane, WA 99201-1080
Wyoming	Federal Building, 100 "B" Street, Room 3124, Casper, WY 82601

In addition to state reports, a Water Supply Outlook for the Western United States is published by the Soil Conservation Service and National Weather Service monthly, January through May. Reports may be obtained from the Soil Conservation Service, West National Technical Center, 511 Northwest Broadway, Room 248, Portland, OR 97209-3489.

Water supply reports published by other agencies:

California — Snow Survey Branch, California Department of Water Resources, P.O. Box 388, Sacramento, CA 95802; British Columbia — The Ministry of Environment, Water Investigations Branch, Parliament Buildings, Victoria, British Columbia, V8V 1X5; Yukon Territory — Department of Indian and Northern Affairs, Northern Operations Branch, 200 Range Road, Whitehorse, Yukon Territory, Y1A3V1; Alberta, Environment Technical Services Division, 9820 106th St., Edmonton, Alberta T5K 2J6.

Montana
Water Supply Outlook

and

Federal - State - Private
Cooperative Snow Surveys

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Programs and assistance of the United States Department of Agriculture are available without regard to race, creed, color, sex, age, or national origin.

ON THE COVER:

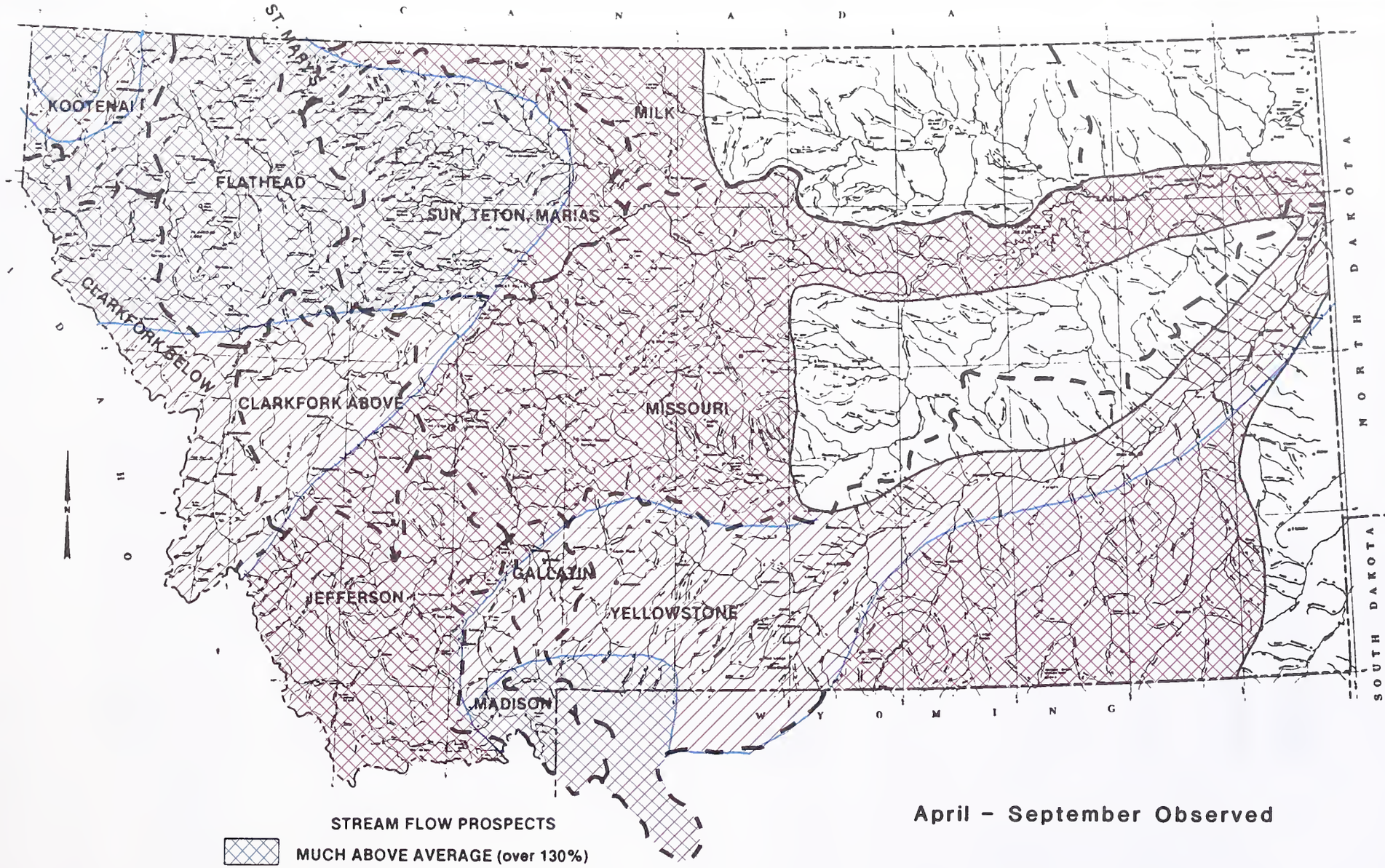
This plaque on the outlet gate at Lake Tahoe, Nevada, commemorates the start of snow surveys in 1909.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

STREAMFLOW PROSPECTS FOR MONTANA

Spring and Summer Period



STREAM FLOW PROSPECTS

- MUCH ABOVE AVERAGE (over 130%)
- ABOVE AVERAGE (110-130%)
- NEAR AVERAGE (90-110%)
- BELOW AVERAGE (70-90%)
- MUCH BELOW AVERAGE (below 70%)
- NOT FORECAST

April – September Observed

Provisional Data

0 25 50 75 100 MI

0 50 100 150 KM

SOURCE:
Information provided by SCS Snow Survey Personnel.

JUNE 1985 4-R-39296

General Outlook

Gerald A. (Jerry) Beard has been selected as the Bozeman Data Collection Office (DCO) supervisor. The Bozeman DCO is responsible for collecting SNOTEL, snow course and related mountain climatological data in Montana and in the Upper Missouri River Drainage in Wyoming and South Dakota. He replaces Phillip E.(Phil) Farnes who has been reassigned as Water Supply Specialist (WSS) for Montana. The WSS is responsible for interpreting the current water supply, preparing the Water Supply Outlook Reports, Reservoir Operating Guides, Hydrology Reports and studies of Mountain Hydrology and Climatology.

Summary

Previous dry years, the effects of the fires during the summer of 1988 and dry soils were of major concern going into the 1989 Water Year. Most areas received adequate snowpack, generally well spaced spring moisture and very orderly snowmelt which was better than in previous years. In most areas streamflows were adequate for irrigation, recreation and power generation. Flows in the southwest corner of the state were deficient with some shortages developing further downstream in the Missouri River System. Runoff from the Bighorn Mountains in Wyoming was also well below average. Some areas presently have below average amounts of soil moisture which will require some of next season's snowmelt to prime these soils. The state will again be dependent on receiving an adequate snowpack and near normal spring rains in order to receive good streamflows next year.

Snowpack

Snow accumulation started around mid-November in most mountain watersheds. This is about one to one and one-half months later than normal for higher elevations. Soils under the snowpack were drier than usual due to the dry summer and lack of fall moisture over most of the state. Areas west of the Divide near Canada did have near average soil moisture levels going into the winter. With the late start snowpacks on January 1 were below average over most of the state. Mountain snowfall was fairly consistent through the winter and by April 1, snowpacks were near average in the western one-fourth of the state and below average in the remaining mountainous areas east of the Divide. Above average snowpack covered much of the Yellowstone and Madison River Headwaters. Warm weather in April decreased snowpacks and the trend continued into May.

Precipitation

October and November mountain precipitation was generally near or above average over most of the state. In general, northern basins received more moisture than the southern areas. December precipitation was generally below average, January above average, February below average and March above average. West of the Divide, April precipitation was a little below average. In southwest Montana, both April and May moisture was below average. The Yellowstone, parts of the Missouri and areas west of Great Falls had above average moisture for both months. June was drier than normal over most of the state. July was dry in southwest areas but average or above in most other areas. August moisture was near to above average while September was generally dry over most of the state.

Reservoirs

In general, most irrigation reservoirs in southwest Montana currently have well below average storage while those in the Sun, Teton, Marias and St. Mary River Drainages generally have above average storage. Most other reservoirs have near average amounts of stored water for this time of year.

Streamflow

Runoff from spring snowmelt was quite orderly. Warm weather in April removed some of the lower elevation snows and then temperatures cooled. Another warm spell in May produced the largest runoff of the season on most streams in the state. However, peak snowmelt runoff was generally below average. Another warm period in June brought out most of the remaining snowpack from higher elevations. With the runoff spread over a longer period, water users were able to make maximum use of the runoff. Streamflows for the April through September period were near average in the Upper Yellowstone and Madison River Drainages, in most of the Sun, Teton, Marias, St. Mary and Flathead River Drainages and on lower tributaries to the Clark Fork and Kootenai Rivers. Below average runoff occurred in the Bitterroot and part of the Upper Clark Fork west of the Divide and over much of the Yellowstone River tributaries. Remaining areas, particularly the southwest corner of the state, experienced well below average runoff. Impacts of the 1988 fires appears to be a little less than expected but with some small increases in watersheds with extensive burned areas.

Soil Moisture

Mountain soils in the southern part of the State are generally drier than normal while those in the northwestern areas generally have near average moisture levels.

1989 SNOW COVER COMPARISONS

(as a percent of average)

RIVER BASIN and/or SUB-WATERSHED	JAN 1	FEB 1	MAR 1	APR 1	MAY 1
COLUMBIA RIVER DRAINAGE					
Kootenai	72	92	81	96	87
Flathead	89	102	90	103	93
Upper Clark Fork	68	90	89	98	80
Lower Clark Fork	83	91	82	93	78
Bitterroot	90	96	87	96	76
MISSOURI RIVER DRAINAGE					
Jefferson	97	106	94	99	80
Madison	102	101	98	109	91
Gallatin	83	85	81	90	78
Missouri Main Stem	71	90	92	95	80
Judith-Musselshell	63	82	82	87	82
Sun-Teton-Marias	83	99	89	96	94
Milk	65	89	86	96	91
YELLOWSTONE RIVER DRAINAGE					
Yellowstone (above Bighorn)	78	86	85	97	85
Bighorn	77	79	79	93	74
Little Big Horn	71	79	72	80	65
Tongue	73	73	64	75	67
Powder	60	63	61	72	50
SASKATCHEWAN RIVER DRAINAGE					
St. Mary	69	90	85	97	85

MOUNTAIN PRECIPITATION

1989 Water Year

PERCENT OF AVERAGE BY BASIN

	JUNE	JULY	AUG	SEPT	WATER YEAR OCT 1 THRU SEPT 30
KOOTENAI	51	82	231	71	99
FLATHEAD	79	141	192	86	108
CLARK FORK (ABOVE)	74	109	236	46	100
CLARK FORK (BELOW)	62	96	179	39	98
JEFFERSON	65	72	151	61	86
MADISON	66	61	108	52	90
GALLATIN	88	68	101	45	87
MISSOURI	94	106	168	77	97
SUN-TETON-MARIAS	102	257	226	68	116
ST. MARY/MILK	117	127	201	66	113
YELLOWSTONE	75	73	110	45	96

RESERVOIR STORAGE (Thousand Acre-Feet) End of Month September 30, 1989

BASIN OR STREAM	RESERVOIR	USEABLE CAPACITY	USEABLE STORAGE THIS YEAR	USEABLE STORAGE LAST YEAR	USEABLE STORAGE AVERAGE
	COLUMBIA				
Kootenai	Koocanusa	5,748.2	5,095.0	4,223.0	5,164.0
Flathead	Hungry Horse	3,451.0	2,157.0	1,694.0	3,189.0
	Flathead Lake	1,791.0	1,786.0	1,690.0	1,735.0
	Camas (4)	45.2	13.4	6.2	18.1
	Mission Valley (8)	100.3	41.6	6.6	26.8
Clark Fork	Georgetown Lake	31.0	26.0	25.0	28.3
	Lower Willow Creek	4.9	---	0.3	0.9
	Nevada Creek	12.6	7.7	0.2	4.0
	Noxon Rapids	334.6	319.6	318.2	326.4
Bitterroot	Painted Rocks	31.7	-0-	1.0	22.6
	Como	34.9	3.8	3.3	2.5
	MISSOURI				
Beaverhead	Lima	84.0	6.1	5.1	30.0
	Clark Canyon	255.6	44.3	76.2	120.6
Ruby	Ruby	38.8	1.8	1.5	11.8
Madison	Hebgen Lake	377.5	329.5	314.4	336.5
	Ennis Lake	41.0	37.1	36.7	36.7
Gallatin	Middle Creek	8.0	3.1	3.0	3.1
Missouri	Canyon Ferry	2,043.0	1,445.0	1,406.0	1,748.0
	Hauser & Helena	61.9	62.5	63.1	58.9
	Helena Valley	9.2	2.6	6.8	6.9
	Lake Helena	10.4	10.7	10.9	10.4
	Holter Lake	81.9	81.1	81.4	77.8
	Fort Peck Lake	18,910.0	12,440.0	13,700.0	16,090.0
Smith	Smith River	10.6	1.2	0.3	5.6
	Newlan Creek	12.4	8.5	0.2	10.1
Musselshell	Bair	7.0	2.8	0.0	3.2
	Martinsdale	23.1	7.7	0.2	9.7
	Deadman's Basin	72.2	13.0	7.5	35.4
Sun	Gibson	99.1	71.0	6.6	29.1
	Willow Creek	32.2	29.6	7.1	19.4
	Pishkun	32.0	7.7	11.1	16.7
Marias	Lower Two Medicine	11.9	11.9	8.1	4.6
	Four Horns	19.2	14.1	8.6	11.6
	Swift	30.0	14.2	6.2	11.9
	Lake Frances	111.9	96.3	45.2	71.2
	Elwell (Tiber)	1,347.0	817.1	676.2	606.7
Milk	Beaver Creek	3.5	0.9	0.4	2.1
	Fresno	127.2	48.7	15.8	67.6
	Nelson	66.8	37.0	5.6	42.2
	HUDSON BAY				
St. Mary's	Lake Sherburne	64.8	23.2	6.6	7.6
	YELLOWSTONE				
Stillwater	Mystic Lake	21.0	17.5	19.9	19.5
Clark's Fork	Cooney	27.4	17.4	11.0	13.2
Tongue	Tongue River	68.0	10.0	21.9	24.8
Bighorn	Bighorn Lake	1,356.0	867.3	793.9	749.0

Water Supply Outlook Reports

Printing of the Montana Water Supply Outlook Reports will cease with this publication. The time and costs of printing and mailing this report have combined to make this report an expensive service with less than maximum beneficial use. Also, this report was generally received too late to be used for operational decisions.

Effective January 1, 1990, this information will be released through Soil Conservation Service (SCS) field offices in each county and by computer access.

Those currently receiving the Water Supply Outlook Report should receive notice of this change.

Forecasts and general outlooks for major river basins in the Western United States will continue to be published in the Water Supply Outlook Report for the Western United States which is still available in printed form.

The snow survey and mountain precipitation data for the previous year will continue to be published in the Annual Data Summary for Montana.

The information available through the Centralized Forecast System (CFS) computer in Portland, OR, and the SCS field offices, will include statewide and basin narratives, streamflow forecasts, snow survey and mountain precipitation data, reservoir storage for each of 15 basins, individual snow and precipitation measurements, and daily SNOTEL readings. All historic data for precipitation, streamflow, SNOTEL, snow course and reservoir storage is also available on CFS.

If anyone has problems obtaining data either via computer access or through their local SCS field offices, please contact the Snow Survey Data Collection Office:

USDA-SCS-Snow Survey Office		Phone:
Federal Building, Room 443	OR	(406) 587-6843
10 East Babcock		[FTS 585-4843]
Bozeman, MT 59715		

If you have a computer with modem and desire to access CFS, or if you need training on computer access or need the location of your local SCS field office, contact the snow survey office.

Our desire is to provide more timely, accessible data and information directly to the user at lower costs.

The Following Organizations Cooperate With The Soil Conservation Service In Snow Survey Work

Canadian

Department of the Environment
- Atmospheric Environment Service
- Water Management Service

British Columbia Ministry of Environment
- Inventory and Engineering Branch, Hydrology Section

Alberta Environment
- Technical Services Division

Federal

U.S. Department of Agriculture
- Forest Service

U.S. Department of the Army
- Corps of Engineers

U.S. Department of Commerce
- NOAA, National Weather Service
- National Environmental Satellite Service

U.S. Department of the Interior
- Bureau of Indian Affairs
- Fish and Wildlife Service
- Geological Survey
- National Park Service
- Bureau of Reclamation

U.S. Department of Energy
- Bonneville Power Administration

State

Montana Conservation Districts
Montana Department of Fish, Wildlife, and Parks
Montana Department of Natural Resources and Conservation
Montana Department of State Lands
Montana State University - Agricultural Experiment Station
University of Montana - School of Forestry

Private

Big Sky of Montana
Butte Water Company
Confererated Salish & Kootenai Tribes
Flathead Valley Comminity College
Montana Power Company
Pondera County Canal & Reservoir Company

Other organizations and individuals furnish information for the snow survey reports.
Their cooperation is gratefully acknowledged.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SNOW SURVEY UNIT
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